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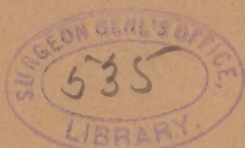
FRACTURES OF THE SKULL.

*Conclusions Drawn from Three Hundred
Cases.*

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FRACTURES OF THE SKULL.—CONCLUSIONS DRAWN FROM THREE HUNDRED CASES.¹

BY J. G. MUMFORD, M.D.

DURING the past summer I made a study of the records of three hundred cases of fracture of the skull which have been entered at the Massachusetts General Hospital in the last twelve years.

The results of this research are mainly interesting as confirming and accentuating much that has been already written, and perhaps throwing new light on the subject of fractures of the base, and causes of head injuries.

Statistics are proverbially unsatisfactory and misleading. In this study, where the diagnosis was questionable, I have weeded very largely and in drawing some of the more encouraging conclusions I have erred, if at all, in making my totals too low rather than too high.

I shall name some figures which are of general rather than scientific interest. For instance, it is a rather striking fact that out of 300 cases of skull fracture, but nine were in females; due, of course, to woman's lack of exposure and her more sedentary occupation.

The mortality in this list I find considerably higher than is usually estimated; 170 of the patients died, and 130 made a recovery, so far as the immediate records show, the mortality being 56.6%. There were 165 fractures of the vault; and 135 of the base, or base and vault combined.

¹ Read before the Suffolk District Medical Society, December 7, 1891.

The difficulty of exact diagnosis in skull fractures is not to be lost sight of, and I have attempted, so far as the reports allow, to record those only where there is no reasonable doubt of the condition.

In considering fractures of the vault the greatest difficulty exists often in cases where the skin is unbroken. For this reason I am convinced that very many times a fracture may exist without positive proof of its presence. Hæmatoma of the scalp is so common after injuries to the head that surgeons are very chary of making the diagnosis of fracture as this condition so often simulates fracture on palpation. This statement is more especially true of the methods of five years and more ago. To-day, very often, and properly, the suspicious area is explored.

On account, perhaps, of this uncertainty in the diagnosis of simple fractures, the proportion of compound fractures in these tables is very large. There are 279 compound fractures and but 21 simple fractures. When we consider that nearly all evident fractures of the base must be compound and that blows on the vault sufficiently violent to break the bone must usually tear the scalp these figures are not surprising.

Most writers ascribe fractures of the skull to blows and falls on the head. This, of course, is true; but I have taken the liberty of adding a distinct class which I will call *railway fractures*. These injuries are far the most serious that we have to meet with in civil life. Indeed, more than one-third of the deaths recorded here are from this cause.

I find that fractures from *blows* on the head are usually recovered from; that after fractures from *falls* on the head about 50% die; and that of the *railway fractures* 74% are fatal. Indeed, when I come to a case of railway fracture in reading over my list, I expect to find the death recorded. By railway fracture

I mean only those cases where the momentum of a moving train is the main factor in the injury. To fall from a moving train or to be struck by an overhead bridge when the impact is received on the head seem to be accidents nearly as fatal as being run over. I have records of 90 railway fractures, of which 67 were fatal. Electric-car accidents seem to be nearly as serious, but too few of these are recorded to provide any basis for conclusions.

A very large number of fractures of the vault are complicated by extension to the base, as evidenced from symptoms and autopsies. I saw myself a very frightful example of this style of injury at the hospital some years ago. The patient was a child, the whole anterior third of whose skull was cracked off, as though he had received a blow which the old military writers describe as cleaving to the chin. The brow and upper part of his face could actually be lifted forward. The anterior lobes of the brain were, of course, extensively lacerated, and in this condition he lived about six hours.

This leads me to speak of the length of life in cases of fatal skull fractures. Such an estimate from hospital records is difficult, as doubtless a few quickly fatal cases fail to reach the hospital. To the best of my judgment I conclude that cases of immediate death from head injuries are extremely uncommon; but the opinion of a medical examiner would be more conclusive on this point. The fatal cases recorded lived after the injury anywhere from one hour to six weeks, the average being about two days, though actually the great proportion died in about six hours.

I cannot say that the general mortality has materially diminished during the past five years. In the whole list there are but 19 cases reported as dying of sepsis, as shown by autopsy records, 13 of these were

prior to the year 1885. Curiously enough one fatal recent case followed two months after an operation for traumatic epilepsy, and was not immediately due to infection at the time of the original injury. Of the nineteen cases, six fractures of the vault were trephined; three were fractures of the base, and were not trephined.

There is little evidence to show that patients frequently die of sepsis in fracture of the base, though this must not be taken as an argument for not using every precaution against infection. In this list are 135 cases of base fracture. Of these a large percentage died, and all but three within a few hours of the time of injury — too short a time for sepsis to have developed — showing how small a share this factor has in the fatality. A certain percentage, to me surprisingly large, recovered without septic symptoms. This may prove nothing or it may prove that the membranes of the brain, like the peritoneum, have high resisting qualities against infection. This conclusion is still more strongly borne out when one considers the great number of compound fractures. Of 149 compound fractures of the vault, 87 recovered, so that here the mortality was but 41%; and when one considers the infinite chance of infection offered, he is inclined to believe the unbroken dura as good a barrier against the invasion of micro-organisms as is absorbent cotton. It is for this reason that extensive compound fractures of the skull are so little harmful when unaccompanied by brain laceration, intra-cranial hæmorrhage or depression of fragments. This immunity from sepsis, and the fact that the bone injuries in themselves are trivial, makes operations on the skull comparatively harmless, and emphasizes the desirability of exploration whenever there is the least serious doubt as to the nature of the lesion. There is no case recorded in

this list where an exploration through the sound skin after an accident did harm, though to be sure the operation is necessarily an infrequent one as the great majority of these fractures are compound. The operation of trephining was done 62 times: 28 of the patients died. A mortality of 45%; but the operation was undertaken oftentimes in desperate cases, and, even when the patient did not survive, there was not seldom a temporary alleviation of symptoms.

On the other hand, the advantages of trephining may be most permanent and astonishing. The brain may be extremely compressed by accumulations of blood, and enormous masses of clots are sometimes turned out. When one considers the extreme readiness with which the brain bleeds and the difficulty of primarily checking this hæmorrhage, he will the more realize the advantage and necessity of free drainage. It seems that the most important factor in brain lacerations is the subsequent hæmorrhage rather than the direct damage to the brain itself. Every surgeon knows that the brain may be quite extensively handled and explored, and portions of it even removed, with no subsequent ill-effects if the resulting hæmorrhage be properly checked and drained aseptically.

As for the diagnosis of fractures of the vault, these cases give very little light. There is a case of great value reported by Drs. Homans and Walton, of suspected fracture in the *right* parietal region, where a hæmatoma without fracture was proved by exploration. Eleven days later, the patient in the meantime being supposed convalescent, convulsions of the *right* side and other symptoms appeared, pointing to pressure in the *left* tempero-parietal region. Exploration at this point, by the advice of Dr. Walton, demonstrated a subdural clot due unquestionably to contre-coup. The patient made a satisfactory recovery with disappearance

of symptoms after the clot and large quantities of lacerated brain tissue had been evacuated.

A comparison of such a case as this with those of genuine fracture simply goes to show that the actual fracture of the bone may be, and usually is, of very great insignificance. A train of symptoms of brain compression may exist with or without fracture and the indication must be for the repair of the localized lesion which unquestionably exists.

That slight hæmorrhage may exist without doing any great amount of harm is perfectly true, but a train of compression symptoms lasting for days must call for and indeed does receive operative relief.

There are certain symptoms in head injuries the value of which seems very uncertain. The state of the pupils has always been considered important; and I must leave it to the neurologists to determine their value. To the surgeon their state when equally contracted or dilated is of questionable importance as regards prognosis; and I am informed by one of our oculists who has been making some study of the condition of the pupils in connection with diseases of the ear, that the pupils vary greatly under apparently similar condition — due probably to some obscure neurotic state, for want of a better explanation. Certainly in cases of skull fracture we see the pupils vary greatly in the same patient and in different patients under similar conditions. The presence of irritation or of pressure from some cause is usually suspected, but the offending factors not infrequently disappear with such marked rapidity as to leave one more in the dark than ever. Unequal and non-reacting pupils, however, have usually a distinct significance, as indicating local trouble, though even here this symptom may be but a temporary one. Unfortunately the incomplete state of many of the records prohibits drawing any satisfac-

tory and exact conclusions for the surgeon's guidance; and I am unable to see that the fact of reaction or non-reaction of the pupils has any especial bearing on the prognosis.

There is a train of symptoms familiar enough to every man of experience, on which one may base an almost positive prognosis: There were 90 cases with coma, stertor, slow pulse and unequal or dilated pupils; 87, or 96%, died. On the three that recovered the trephine was used, when the condition seemed hopeless.

Exactly what these symptoms mean beyond the vague expressions *hæmorrhage*, *pressure* and *paralysis*, it is difficult to say except in individual cases. There is often difficulty at the base which cannot be demonstrated. On the other hand, extensive hæmorrhage may cause such pressure at the vault that all the intracranial conditions are altered, and the base thus indirectly affected.

All of these various symptoms are due to pressure, as a rule; and yet similar conditions may excite different symptoms in different individuals. One of the more unusual symptoms is vomiting, which occurred but 32 times in 300 cases (yet these cases did not differ essentially from many where vomiting did not occur). There are various special paralyses of the cranial nerves recorded, which are often difficult to account for. Often no other evidence of hæmorrhage exists, and we must conclude that the nerves are directly involved in the fracture at the point of exit from the skull.

Always in considering secondary symptoms the element of hysteria or other profound nervous disturbance must not be lost sight of. I have in mind one such case in private practice, and know of others, where the nature of the lesion was for some days masked by prolonged unconsciousness and mental disturbance

which later appeared unquestionably to be of hysterical origin. The case was carefully watched by Drs. M. H. Richardson, Walton and myself with a view to operative interference.

There is one variety of fracture of the vault where the diagnosis is usually certain and the method of procedure unquestionable. I refer to gun-shot wounds and fracture from the blow of a sharp-pointed instrument. Here is a fracture which is unquestionably compound; which causes a depression of the inner table; which may have penetrated the dura; which may have lacerated the brain; and which may have caused hæmorrhage. The indication here with very rare exceptions is for immediate exploration in any case; if for nothing else for the sake of elevation and drainage. Seeking for the bullet with Fluhrer's aluminium gravity probe, I have not personal knowledge of; but it is said to be a successful procedure frequently.

My list of cases shows nine gun-shot wounds. Seven of these died. Of these fatal cases three were trephined (the bullet not found), and died of sepsis in from two to six weeks. The remaining four were not trephined, and died from the result of the primary hæmorrhage. Of the two cases that recovered it is difficult to see why the result was not fatal. One received a ball in the mastoid region. Subconjunctival ecchymosis followed, showing injury at the base. The other had a penetrating wound of the vault and made a prompt and uncomplicated recovery.

The high mortality here indicates two things: first that the presence of the ball may be a serious disturbing element leading often to sepsis, and that its removal with the establishment of proper drainage, is therefore most essential; second, that the primary deaths due to hæmorrhage and pressure may be avoided in suitable cases by the immediate establishment of

drainage by operation. If, as is asserted, the gravity probe will discover the ball, its use should certainly never be neglected. The fact that in one of the non-fatal cases the ball apparently passed entirely through the brain without causing any serious hæmorrhage or subsequent sepsis goes to emphasize again the extreme danger of the former (hæmorrhage) and the more than possibility of immunity from the latter (sepsis).

These cases of gun-shot wound may be included in the class of punctured wounds, which are always described as most serious and as demanding immediate operation for the elevation of fragments of the inner table. As a matter of fact, punctured wounds from other causes seem to be very uncommon. There are two others in this list: one from the blow of a pick on the vault, where immediate operation was done and convalescence followed; the other a case where a boat-hook was thrust up the nostril, and recovery without operation followed, though at last accounts there was permanent blindness of one eye.

In this connection I may mention the most unfortunate death of Dr. Terry, of Fall River, last summer, which we all probably recollect. He received a foil thrust in fencing. The weapon entered the right orbit, and passed through its roof without injuring the ball of the eye. Immediate and extensive hæmorrhage, with blindness and paralysis, followed; and death ensued within three hours. Here there was ecchymosis of the lids, but the valve-like nature of the wound of entrance absolutely prevented the external escape of blood.

There is a certain small proportion of cases which die without obvious symptoms of cerebral lesion. These deaths are apparently due to direct injury to the pons and medulla or the nerves of the fourth ventricle. In one case without signs of hæmorrhage or pressure, the

pneumogastric nerves were lacerated, and death followed from pulmonary and cardiac failure without other symptoms.

There are records of four operations for traumatic epilepsy. For the purposes of this paper these may be considered compound fractures of the skull. They have been reported, and of the therapeutic value of the operation it is not necessary to speak. One of them unfortunately became infected, from a bit of buried wax used to check an obstinate hæmorrhage from the middle meningeal artery, and proved fatal after two months. At the autopsy the ventricles were found distended with pus.

Perhaps the most interesting subject in connection with this investigation is that of fracture of the base. It is well recognized that this lesion is not a mortal one *per se*.

In collecting these cases I have endeavored, as far as possible, to cite those only where the diagnosis was beyond all reasonable doubt; and, without question, I may have omitted some where this serious condition went unrecognized. Here the diagnosis is given when based, not on any one sign or symptom, but on groups of symptoms. There are in the list 135 cases of base fracture, of which 108 died, a mortality of 80%. This is more than twice as great as in fractures of the vault, where the mortality was 37.5%.

The diagnosis rests mainly on evidence of hæmorrhage seen and unseen. The most common apparent hæmorrhage is that from the ears, as the impact in fractures of the base is mostly about the foramen magnum and in the middle fossa. The presence of cerebro spinal fluid with the hæmorrhage is not essential in these injuries. When it is remembered that the cavernous, petrosal and lateral sinuses lie in close proximity to the basilar plate and petrous bones, it is

evident that slight injury to these vessels may occasion hæmorrhage without necessarily involving the fluid within the dura. That this may be so is evidenced by an autopsy where there was hæmorrhage from the ear without cerebro-spinal fluid, and where fracture of the base was suspected. The petrous bone and the occiput were found cracked, but there was no evidence of extravasation of cerebro-spinal fluid.

Hæmorrhage from the ears may, of course, be from other causes than fracture; but time or the careful examination of an aurist will usually settle this point.

Hæmorrhage from the nose may also be due to other causes than fracture. It is very common in all injuries to the head. If the blood is mingled with cerebro-spinal fluid, the diagnosis is practically settled, as well as by long continued bleeding, and often by hæmorrhage from the pharynx vault.

Ecchymosis of the lids is not at all diagnostic. It was Dr. R. M. Hodges, I believe, who first pointed out the fact that subconjunctival hæmorrhage is a vastly more important factor.

A perfectly familiar sign of fracture of the occiput which is often overlooked is ecchymosis in the mastoid region. Many cases, of course, die too soon for this evidence to be of value. When it appears, it usually does so in from two to five days after the injury.

There are undoubtedly many cases of fracture where no external hæmorrhage is seen, and where pressure symptoms alone must be relied on. These are too uncertain to use in evidence here.

Almost without exception hæmorrhage, more or less extensive, is the great source of danger in these cases, as in those of fracture of the vault. I refer, of course, to the experience of civil practice: the fearful mangling of the brain so common in actual warfare is almost unknown except occasionally in railway surgery.

This matter of hæmorrhage and its relief is the keynote to the whole subject of treatment and prognosis in those cases which are not immediately fatal; and it is most interesting to note that, in very many of those cases where free hæmorrhage external exists, this is cause for congratulation. Of the 27 cases which recovered, 20 had profuse hæmorrhage from the ears, and five from the nose or nose and ears together. Two had slight hæmorrhages into the orbit and mastoid region, the lesion in both those cases being apparently trivial. Out of the total number of base fractures, 75, or more than 50%, had hæmorrhage from the ear, so that we may say that, given fracture of the base with hæmorrhage from the ear, one-third of the cases recover.

This is rather a remarkable showing and the deduction is obvious; namely, that in fractures of the base free drainage is the one great essential for recovery. That fact was not always recognized at the time of the injury when these records were written, which makes the unconscious evidence of the writers of greater value. In these cases I find it very frequently reported that the hæmorrhage was profuse, was copious, and was long continued.

Writers in recent years have dwelt much on the necessity of the antiseptic treatment of these wounds of the base, and that procedure is certainly a very proper one; but the fact that even in pre-antiseptic days so few of these cases died of sepsis — three out of 108, as shown by autopsy — goes to demonstrate that sepsis must be considered a very remote danger. In the detail of antiseptic dressings to these base fractures great care must be taken to facilitate free drainage. I have seen the ear stuffed so tight with sterilized cotton that the plug entirely checked the external hæmorrhage. A slight gauze wick, frequent irrigation and

a large, loose external pad make the most suitable dressings in these cases.

When the hæmorrhage comes from the nose or pharynx, there is less danger of doing damage by plugging; but it is also much more difficult or impossible to render the parts aseptic. Frequent douches, drying powders and gauze drains may, however, be used with advantage.

When all the mild and palliative measures have been used, the important question of drainage still remains to be met, and though our data are not yet large enough to admit of laying down a hard and fast rule, such cases as we have go to show that always when fracture of the base is apparent, when the source of hæmorrhage is not beyond exploration, and when the patient's strength admits, the trephine should be used. A few notable cases have already been reported where success followed the operation, and these cases should encourage the surgeon under similar circumstances.

I have not attempted in this sketch to do more than follow out the obvious lines of thought suggested by the records. Incomplete as these records necessarily are, their significance seems to me unquestionable: that the bone injury in itself is insignificant, that the danger of sepsis is remote when the membranes are intact, that base fractures are not necessarily fatal, and that removal of pressure and free drainage is the one great essential in the surgeon's treatment of all cases.

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